



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Chemical Engineering

(Green Technology and Sustainability Engineering)

Subject Code: BE05044031

Subject Name: Chemical Process Plant Design and Economics

W. E. F. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Core

Prerequisite:	Basic Concepts of material and energy balance, unit process and operations, and chemical technology.
Rationale:	This program integrates the principles of engineering and economics, specifically focusing on chemical process and plant design. It emphasizes the decision making process involved in creating and evaluating chemical processes and their options. The course aims to encourage chemical engineers to synergize fundamental technical knowledge from their prior studies with real-world economic considerations, business methodologies, organizational insights, as well as safety, environmental, and sociological concerns. The ultimate goal is to enable the design of comprehensive and interconnected chemical process plants.

Course Outcome:

After Completion of the Course, Student will able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Explain basic process design principles and types of flow diagrams.	16
CO-2	Select suitable process equipment and materials of construction.	10
CO-3	Describe process utilities, piping systems, valves, and instrumentation.	18
CO-4	Analyze factors affecting plant location and plant layout.	12
CO-5	Estimate capital investment, production cost, and break-even point.	22
CO-6	Evaluate depreciation methods and profitability of process plants.	22



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Teaching and Examination Scheme:

Teaching /Learning Scheme in Hours Per Semester					Total Credits = TH/30	Examination Marks					Total Marks
L	T	P	PBL	TH	03	Theory Marks		Practical Marks			
						ESE (E)	PA (M)	ESE (V)	PBL	PA (I)	
45	0	0	45	90			70	30	0	30	0

Course Content:

Sr. No.	Content	Total Hrs
1	Introduction and Process design aspects : Basic design, optimization, selection of process-factors affecting process selection. Types of project design, Importance of Laboratory development pilot plant, safety factors, types of flow diagrams.	6
2	Selection of process equipments : Standard versus special equipment material of construction for process equipments, selection criteria, and specification sheets.	4
3	Process auxiliaries and Process utilities : Piping design, layout, and supports for piping insulations. Pipe fittings, types of valves, selection of valves, process control and instrumentation control system design. Process water, boiler feed water, water treatment, waste treatment and disposal, disposal, steam, oil heating system, chilling plant, compressed air and vacuum.	7
4	Plant location and layout : Factors affecting plant location, factors in planning layouts, principles of plant layout, Unit plot plan, vertical and horizontal lay out.	4
5	Cost estimation : Cash flow and cumulative factors affecting estimation of investment and production cost, breakeven point and its significance, total capital investment, fixed and working capital investment & their estimations, type of estimates, cost indexes, method for estimating capital investment. Simple and compound interest.	7



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Estimation of total product cost : Manufacturing cost, general expenses, Manufacturing cost: direct production cost, fixed charges, plant overhead cost.	5
Depreciation : Types of depreciation, Method for determining depreciation: straight line method, decline balance method, sum of the year digit method, shrinking fund method etc., single unit and group depreciation, adjustment of depreciation account, evaluation of depreciation methods.	6
Profitability, alternative investments and replacement : Methods for profitability evaluation, Evaluation of Break Even Point, % rate of return, Practical factors in alternative investment and replacement Studies.	6

Sustainability alignment:

This course addresses SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) by developing skills in process design, plant layout, cost estimation, resource optimization, and sustainable industrial management practices essential for efficient and environmentally responsible chemical industries.

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	26	23	7	0	0

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate
C: Create and above Levels (Revised Bloom's Taxonomy)**

Reference Books:

1. Smith, R., Chemical Process: Design and Integration, John Wiley and Sons, West Sussex, UK (2005).
2. Peters, Max S., K.D. Timmerhaus and R.E. West, Plant Design and Economics for Chemical Engineers (5th Ed), McGraw-Hill International Editions (Chemical Engineering Series), New York, USA (2003).
3. Coulson and Richardson's Chemical Engineering, Vol. 6: Chemical Engineering Design. By R.K. Sinnott, Butterworth-Heinemann, Oxford, 3rd, Ed., 1999, 1994.



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Open source software and website:

Students can refer to video lectures available on the websites including NPTEL.

Activities suggested under self learning:

Sl. No.	Name of the activity	No. of hours	Total Hours
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h	10
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h	10
3.	Assignment writing. Numerical based assignment is preferable.	5 assignments of 2h each.	10
4.	Self learning on-line course	Minimum duration of the course should be 10h.	10
5.	Complex problem solving	Maximum 2 problems. Study of the problem and solution finding.	10
6.	Poster/chart/power point preparation on technical topics		6
7.	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h	10
8.	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	
